The Factory:
Strategies in Problem Solving

Teacher's Guide

Acorn
Apple
Commodore 64
IBM PC/PC Jr.
TRS-80 Color
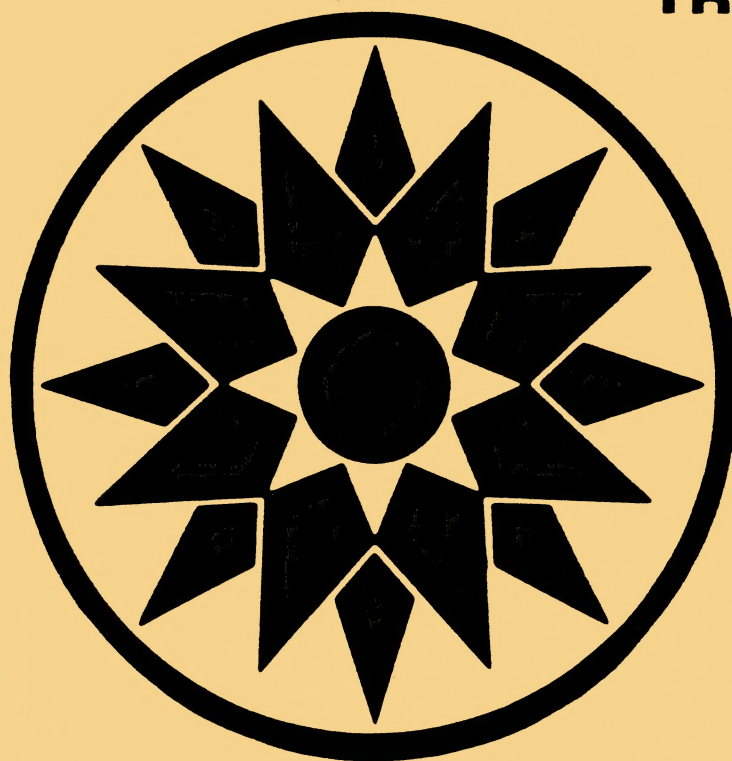
SUNBURST
COMMUNICATIONS

The Council for Exceptional Children

1983 NATIONAL SOFTWARE CONTEST

HONORABLE MENTION
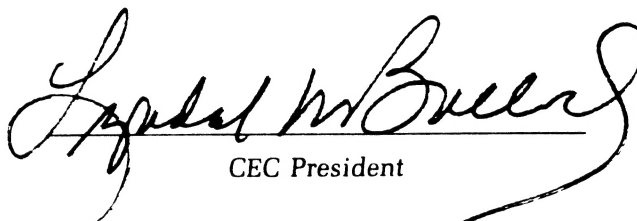*COMMERCIAL CATEGORY*
THE ASSOCIATION FOR THE GIFTED

is hereby awarded to

Sunburst Communications, Inc.

for the microcomputer software program entitled

"The Factory: Strategies in Problem Solving"

The Council for Exceptional Children hereby acknowledges and commends this contribution to the education of exceptional children and youth.

_____
CEC President

This contest was supported by The Johns Hopkins University and its affiliate the John F. Kennedy Institute

THE BEST MICRO-COMPUTER SOFTWARE OF THE YEAR

THE LEARNING

COMPUTER SOFTWARE AWARDS

Presented by the LEARNING PERIODICALS GROUP:

LEARNING
CLASSROOM COMPUTER LEARNING
CURRICULUM PRODUCT REVIEW
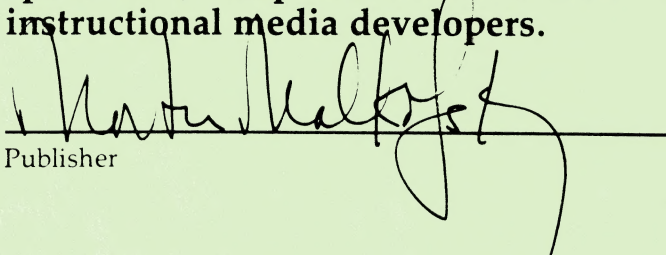*EDUCATIONAL DEALER*

Awarded to

Sunburst Communications

For

The Factory: Explorations in Problem Solving

All entries in this annual evaluation were judged by teachers, subject specialists, computer educators and instructional media developers.

1 9 8 3

Publisher

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1 9 8 3

Publisher

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The Factory: Strategies in Problem Solving

INTRODUCTION

"The most significant change in the curriculum of
the next ten or twenty years will be to place great
emphasis on realistic, non-routine problem solving.
Most recently the National Council of Teachers of
Mathematics (1980) issued recommendations regarding
the teaching of problem solving. A key feature of
those recommendations is that the curriculum be
organized around problem-solving with instruction
in a broad range of strategies and processes. The
movement toward the use of problem solving strategies
and processes is not confined to any one discipline.
In any discipline, the intellectual needs of our
time, in light of our technological capabilities,
mean developing problem-solving skills."

Eileen K. Gress, <u>The Computing Teacher,</u> September 1981

If the curriculum is to change to a problem solving approach to learning,
teachers must be given tools to teach problem solving techniques. The
Factory and other Sunburst programs identify unique problem solving skills,
and then put students in an environment where those skills can be utilized.

As a basis for the development of problem solving material, we have adapted
a Problem Solving Skill Matrix devised by a group of teachers in Rochester,
Minn. under the direction of Donna Stanger. The matrix (see page 3)
divides problem solving into four categories:

> Memory
> Cognitive Skills (Discrimination, Rules, and Attributes)
> Strategies
> Creativity

The Factory is designed to teach the third category, Strategies. It focuses
on several of the strategies: working backwards, analyzing a process,
determining a sequence and applying creativity.

The first level of the program allows students to experiment with three
machines. The students' creativity can be expressed in the second level of
the program where they can design products, try to produce them using
combinations of the three machines, and then challenge other students to
produce them. In the third level, students are asked to look at a final
product, and then work backwards to determine what process took place to
construct the product. In order to perform the task, students must know
the function of each machine and devise a sequence which will produce a final
product.

The Factory teaches the students the strategy of working backwards. When
working backwards, you solve the problem by determining what the final
result should be and then working backwards to find what steps will give you
that result.

The program also involves strategies such as:

    Analyzing - Breaking down the problem, solving it in parts if possible, and identifying necessary and unnecessary information.

    Looking for a Sequence - Finding order and discovering relationships.

Other skills developed by The Factory include:

    Visual reasoning - The ability to analyze an object that is visually presented.
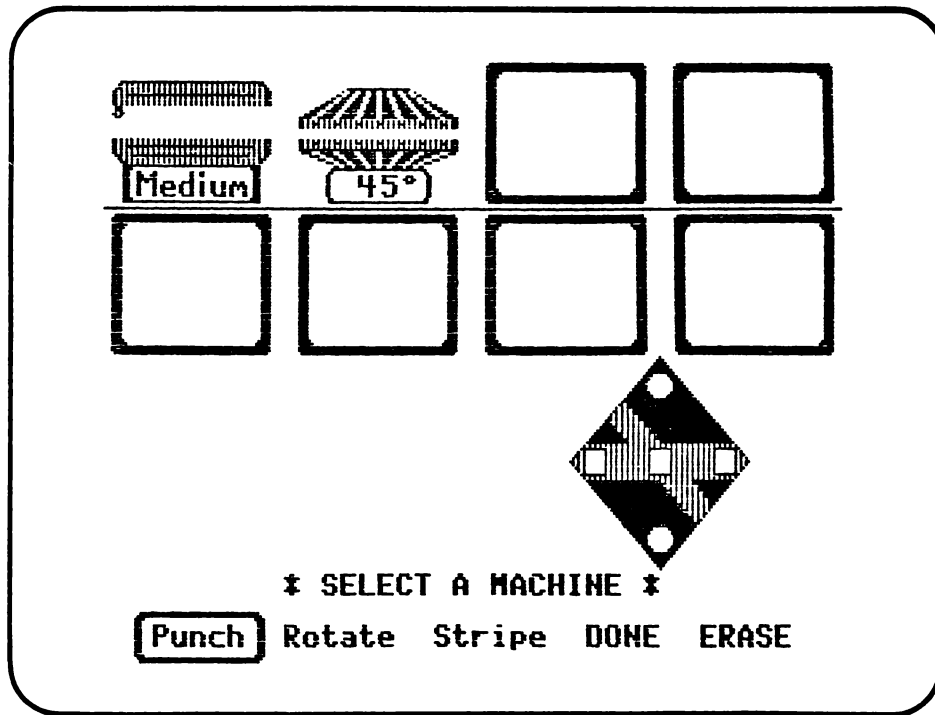
    Rotation - Understanding and applying the mathematical concept involving the number of degrees in a turn.

The programs are designed for a 64K Acorn, with disk drive; a 48K Apple II with Applesoft, Apple II plus or Apple IIe; a Commodore 64 with disk drive; a 64K IBM PC or 128K PCjr; or a 32K TRS-80 Color Computer with disk drive. If you need assistance in operating your computer, check the sections of this Teacher's Guide entitled, "Working with Your Computer" and "What Happens If...?". You can also call Sunburst Communications toll-free at (800) 431-1934.

Problem Solving Skill Matrix

The Factory:

MEMORY	COGNITIVE SKILLS	COGNITIVE CONTROL STRATEGIES	CREATIVITY			
			Fluency	Flexibility	Originality	Elaboration
• Mnemonic Systems		• Simultaneous Scanning				
• Visual Association		• Selecting Appropriate Notation				
• Whole to Part		• Identifying Multiple Solutions				
• Self Testing		• Examining Assumptions				
• Creating a Context	• Higher Order Rules	• Working Backward				
• Personalization		• Using a Model				
• Regrouping	• Rules	• Focus Gambling				
• Auditory Aids	• Defined Concepts	• Conservative Focusing				
• Number of Items to Remember	• Concrete Concepts	• Estimating, Predicting, Projecting				
• Sequence	• Discrimination	• Scanning for Clues, Hints				
		• Restating the Problem				
		• Analyzing				
		• Making Organized Lists				
		• Looking for a Pattern or Sequence				
		• Brainstorming				
		• Openness to Insight, Flexibility				
		• Successive Scanning				
		• Retrieval Strategies				
		• Information Gathering				
		• Problem Finding				

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THE FACTORY

Skills:	Visual discrimination, spatial perception, logic
Students Work With:	Sequence Rotation Working backwards
Grade Level:	4 - 9
Reading Level:	2nd grade
Time Required:	10-20 minutes

Objectives:

1. To develop visual discrimination and spatial perception.

2. To gain experience in understanding the importance of sequence and order.

3. To gain experience in using the cognitive strategy of working backwards.

4. To understand that there may be more than one solution to a problem.

Program Description

The program's menu gives students the choice of three activities:

1. Test A Machine
2. Build A Factory
3. Make A Product

Test A Machine

Test A Machine allows students to try each machine to see the effect it has on a raw material. Students should use Test A Machine before they proceed to the other options.

Three machines are available for testing: PUNCH, ROTATE, and STRIPE. The students choose the machine by pressing the arrow keys (◄— or —►), or on the Commodore by pressing the greater than and less than symbols (> or <). When the box surrounds the machine they wish to test, they press the RETURN or ENTER key.
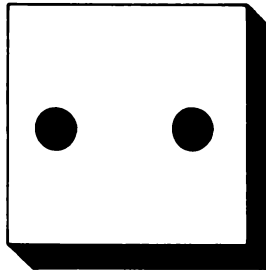
The PUNCH

The students instruct the machine to punch a circle or a square either one, two, or three times.
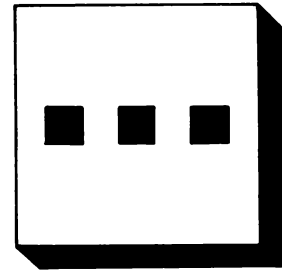
For example:
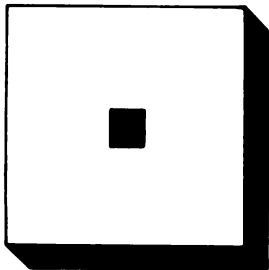
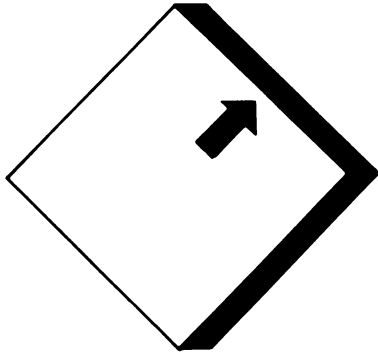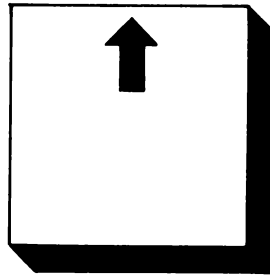| A square punched once | A circle punched twice | A square punched three times |

When selecting the type of punch, a selection called BACK UP is also available. If BACK UP is chosen the students return to the previous choice.

ROTATE

The students can rotate the material 45°, 90°, 135° or 180°.
For example:
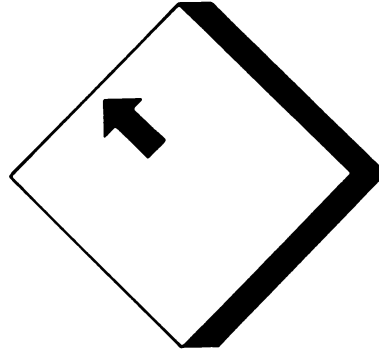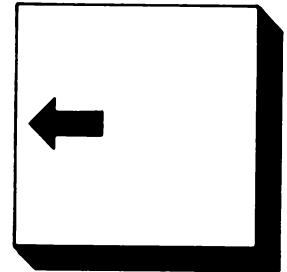
45°	90°	135°	180°

STRIPE

A thin, medium, or thick stripe can be placed on the product.
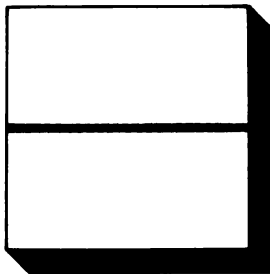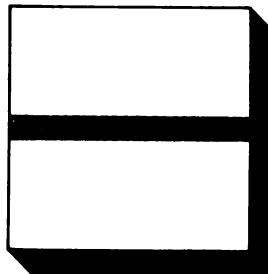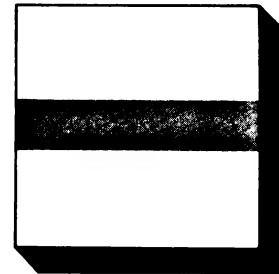
thin	medium	thick

After students are finished testing a machine, the computer will ask if they would like to use another machine. If YES, the PUNCH, ROTATE and STRIPE will appear. If NO, they will be returned to the menu.

At any time during the program, students can stop what they are doing by holding the Control (CTRL) and pressing the E key, or on the TRS-80 by holding down the down-arrow key and the E key.

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Build A Factory

The second activity allows the students to put up to eight machines together, combining them to produce a factory assembly line.

For example:
If the students punch a circle in the center, rotate it 45°, put on a thick stripe, and rotate it another 45°, the following product will be produced:

Students making a mistake while putting the factory together may utilize an ERASE option that appears on the line with PUNCH, ROTATE, STRIPE, and DONE. Moving the box to erase and pressing the RETURN or ENTER key will erase the last machine in their assembly line. A BACKUP option is available when students are selecting the type of punches (circle, square) or other features. Control E, or down-arrow E on the TRS-80, can also be used to start over.
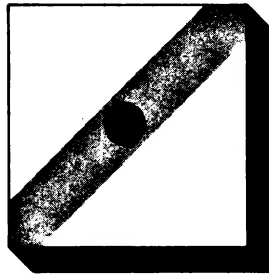
When the students have finished creating an assembly line, they should move the box to DONE and press the RETURN or ENTER key. The gears in the factory will start to rotate and the product will be produced.

After the product is completed, the computer will ask students if they would like to challenge someone to make that product. If they answer "YES", the computer will display the product and challenge the other student to make it. When the other student has found a correct combination of machines, he or she can create another product in the Build A Factory activity.

Make A Product

In the last activity, students are shown a product that has been made by several machines. They are asked to reconstruct the sequence of machines and processes used for its creation.

The students are given the choice of an EASY, MEDIUM or HARD challenge level. An easy level involves the use of two machines, for

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example, rotating 45° and making a wide stripe. A medium level involves up to five machines. A hard level involves up to eight machines.
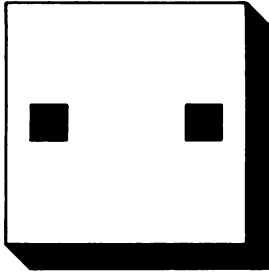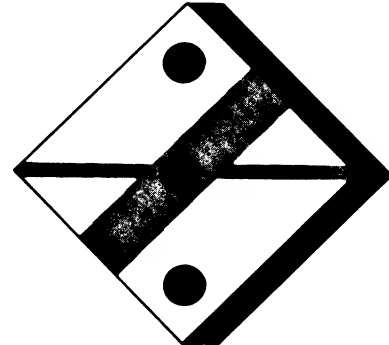
EASY	MEDIUM	HARD

Students must analyze the product and work backwards to identify the machines used to make each of its characteristics. After they have assembled the machines, the product will be processed through the assembly line to determine if it is the same as the original. The product is then declared to have a flaw or to be an exact replica.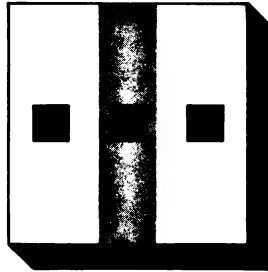 In either case, the students are given the option of trying to recreate the same product again or beginning a new product.

Sound Options:

On the Acorn, Apple, and IBM version, the sound may be turned off by the teacher. This is done by typing a CONTROL T at the program's menu. Answer the question, "Do you want the sound OFF?". Make sure the write protect sticker is removed from the diskette. The sound will be turned off until you do a CONTROL T again.

On the IBM, the student may also turn off the sound with a Control S during the program.

On the TRS-80 and Commodore, the sound control is on the television.

<u>Classroom Use</u>

Preparation:

Before using the program with students, the teacher may want to discuss the mathematical concept of rotation: "What does it mean to rotate an object 45°? 90°? 135°? The concept of rotation could also be left for the students to discover in the program Test A Machine.

Using the Program:

All students should first select the Test A Machine activity and make themselves familiar with how the machines work. The students can then proceed to activities 2 and 3 on the menu to create products. The Factory Product Sheet can be used to record the products made and the machines used. Some variations that have been used in the classroom include-- <u>My Product</u> - Using the Factory Product Sheet, students design their own product on paper and then try to produce it with The Factory. Interesting designs, such as a star, can be formed by punching one square, rotating 45, and punching another square.

<u>Production Efficiency</u> - Using Make A Product, students try to outdo one another by creating the given product in the fewest steps. A random product will be created by the computer. Player 1 tries to make that product. If successful, the same product is selected again and Player 2 tries to make it in fewer steps.

Another variation on this is to challenge both students to make the product in a given number of steps. For example, you can tell the students to use five steps to make a particular product. In the case of a very simple problem, students will discover how to use rotation and other processes which will not be evident in the final product.

<u>I'm in Charge</u> - One student (supervisor) determines what the product will look like by drawing it on the Factory Product Sheet or creating it using activity 2 - Make A Product. The second student (worker) tries to duplicate the first's product using the Build A Factory activity. If the worker fails, the supervisor gets a chance. If the supervisor cannot produce it either, the two exchange roles.

<u>Challenge Sheet</u> - Students try to make products as stated on the Challenge Sheets 1 or 2. Students, also, may make up challenges for other students.

Follow-Up:

1)   Have students go home and look at objects around their house. Tell
     them to:

     "Look at any object. Chances are, it was made in a factory - on an
     assembly line. What kinds of machines might have been used? In what
     order?"

     (For example, a decorated plate. Looking at it, you might imagine at
     least three machines making it: one machine to mix the material it's made
     of; one machine to mold or shape it; one machine to put on the paint.)
     Have them write a paper on how a product might have been
     manufactured.

2)   Brainstorm with the class on when you use the skill of working
     backwards to solve a problem. When do you set a goal for yourself?
     Then analyze the steps it will take to reach the goal. Write different
     examples on the board. Try to identify examples during the week to
     add to the list.

FACTORY PRODUCT SHEET

Name_____ Date_____

Class_____

The Product

The Factory

Machine: _____   Machine: _____   Machine: _____   Machine: _____

Features:_____   Features:_____   Features:_____   Features:_____

Machine: _____   Machine: _____   Machine: _____   Machine: _____

Features:_____   Features:_____   Features:_____   Features:_____

The Product

The Factory

Machine: _____   Machine: _____   Machine: _____   Machine: _____

Features:_____   Features:_____   Features:_____   Features:_____

Machine: _____   Machine: _____   Machine: _____   Machine: _____

Features:_____   Features:_____   Features:_____   Features:_____

FACTORY CHALLENGE SHEET I

1. Can you make these designs on your products?
   A star   A face

2. Can you produce the designs of these flags?
   Austria
   Greece
   Jersey State Flag of the United Kingdom

3. Can you make products that look like these:
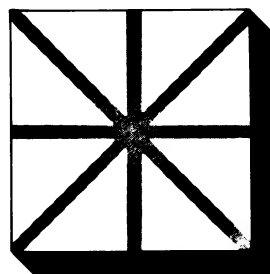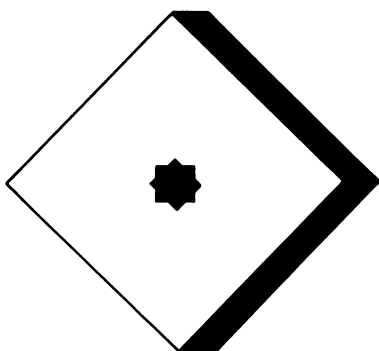
4. Can you make this product:
   Using 8 machines?
   Using 6 machines?
   Using 5 machines?
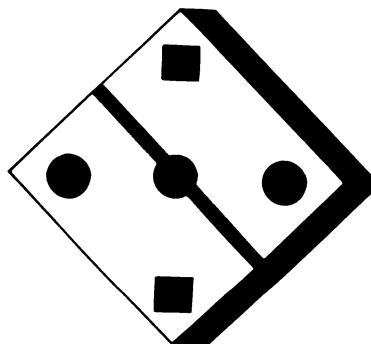
5. Can you make up a challenge for a friend?

FACTORY CHALLENGE SHEET II

1) What's the most machines needed to build an Easy Level product - if you do it as simply and easily as possible? _____

What's the most you need for a MEDIUM LEVEL product? _____

For a HARD LEVEL product? _____

2) Play against the clock:

Keep track of your speed records for matching Easy, Medium, and Hard products. Keep working against your own records.

Best time - EASY _____

MEDIUM _____

HARD _____

When competing, use the clock. How fast can your friend match the product you've designed? How fast can you match your friend's product?

ACORN: WORKING WITH THE COMPUTER

1) Turn on the television or monitor.

2) If your disk drive has a power switch on the back, turn it on at this time.

3) Put the diskette into the disk drive with the label facing up.

4) Close the disk drive door.

5) Turn on the computer.
   You should see:
      ACORN OS
      ACORN DFS
      BASIC

6) Hold the Shift and press the Break key.

7) You should see a red light on your disk drive come on.

8) A SUNBURST Logo will appear on the screen. Follow the instructions in the program.

TURNING OFF THE SYSTEM:

1) Remove the diskette from the disk drive and store it.

2) Turn off the ACORN and the disk drive.

3) Turn off the television.

APPLE II: WORKING WITH YOUR COMPUTER

1)   Turn on the television or monitor.

2)   Insert the diskette into the disk drive with the label facing up and on the right.

3)   Close the door to the disk drive.

4)   Turn on the Apple II. (The on-off switch is on the back left side of the computer.)

5)   You will see a red light on the disk drive turn on. If the disk drive light does not turn off in about 10 seconds, turn the Apple off and make sure your diskette is placed correctly in the disk drive.

6)   SUNBURST will appear on the screen.

7)   Follow directions given in the program.

Turning Off the System

1)   Remove the diskette from the disk drive and return it to its place of storage.

2)   Turn off the Apple.

3)   Turn off the television or monitor.

COMMODORE 64: WORKING WITH YOUR COMPUTER

1) Turn on the television or monitor.

2) <u>The disk drive must be turned on before the computer.</u> Turn on the disk drive (the switch is located at the back right side of the drive).

3) Open the door of the drive by pressing in on the door. Insert the diskete with the exposed oval window inserted first and the label up.

4) Close the door on the disk drive.

5) Turn on the computer. You will see the words--

                    ****COMMODORE 64 BASIC V2****
                    64K RAM SYSTEM 3891 BASIC BYTES FREE
                    READY.

6) Type LOAD "0:*",8 and press the Return Key. The red light on the disk drive will come on. The computer will print--
                    "Searching for 0:*"
                    LOADING.
                    READY.

7) Type RUN.

8) If any time during the program you want to stop, hold the CTRL (Control) key and press the E key.

<u>Shutting off the System</u>

1) Remove the diskette.

2) Turn off the disk drive, computer and television.

IBM PC/PC jr: WORKING WITH THE COMPUTER

1)   Place the diskette in the computer's disk drive with the label facing up
     and on the right. (If there are two disk drives, place the diskette in
     the one on the left.) Close the door of the disk drive.

2)   Turn on the graphics' monitor.

3)   Turn on the computer. In several seconds, you will see the red light
     on the disk drive light up and you will hear the disk drive spinning.

4)   The SUNBURST logo will appear on the screen, followed by a menu of
     the program.

5)   Follow the instructions in the program.

6)   If at any time during the program you want to stop, hold the Control
     key and press the E key.

TURNING OFF THE SYSTEM

1)   Remove the diskette from the drive and put it in a safe place.

2)   Turn off the computer.

3)   Turn off the graphics monitor.

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TRS-80: WORKING WITH YOUR COLOR COMPUTER

1)   Turn on the disk drive.   The switch is located in the back.

2)   Turn on the television or monitor.

3)   Turn on the TRS-80 Color Computer.   The switch is located in the rear.
     On the television screen you will see:

> Disk Extended Color Basic 1.0
> COPYRIGHT (C) 1981 BY TANDY
> UNDER LICENSE FROM MICROSOFT
>
> OK

4)   Insert the diskette in the disk drive with the label facing upward and to
     the right.

5)   Close the drive door.

6)   Type LOADM "FACTORY"
     Press ENTER

7)   The SUNBURST logo will appear on the screen.

8)   Follow the directions given in the program.

Turning off the System

1)   Remove the diskette from the disk drive and return it to its place of
     storage.

2)   Turn off the computer.

3)   Turn off the television or monitor.

4)   Turn off the drive.

"WHAT HAPPENS IF...?" -- SUNBURST COURSEWARE AND WARRANTY

1) What happens if a program will not load or run?
   Call us on our toll-free number and we will send you a new diskette.

2) What if I find an error in the program?
   We have thoroughly tested the programs that SUNBURST carries so we hope this does not happen. But if you find an error, please note what you did before the error occurred. Also if a message appears on the screen, please write the message down. Then fill out the evaluation form or call us with the information. We will correct the error and send you a new diskette.

3) What happens if the courseware is accidentally destroyed?
   SUNBURST has a lifetime guarantee on its courseware. Send us the product that was damaged and we will send you a new one.

4) How do I stop a program in the middle to go on to something new?
   Hold the Control (CTRL) button down and press the E key. On the TRS-80, hold down the down-arrow key and press the E key. Then select the END option on the menu.

5) Can I copy this diskette?
   The material on the diskette is copyrighted. You should not copy the diskette.